RECEIVED
FEB 8 - 1944
O. S. U. LIBRARY

I. C. 7271

JANUARY 1944

UNITED STATES
DEPARTMENT OF THE INTERIOR
HAROLD L. ICKES, SECRETARY

BUREAU OF MINES
R. R. SAYERS, DIRECTOR

INFORMATION CIRCULAR

USE AND MISUSE OF FLAME SAFETY LAMPS

BY

W. H. TOMLINSON

OHIO STATE UNIVERSITY

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google

Digitized by Google

Original from
THE OHIO STATE UNIVERSITY

I.C. 7271,
January 1944.

INFORMATION CIRCULAR

UNITED STATES DEPARTMENT OF THE INTERIOR - BUREAU OF MINES

USE AND MISUSE OF FLAME SAFETY LAMPS 1/

By W. H. Tomlinson 2/

INTRODUCTION

Although the thoughts and efforts of the great majority of people in many parts of the world are today directed toward killing each other, the purpose of this paper is to discuss means of conserving human life. In a world of turmoil and strife, we find time to discuss and make plans to achieve our objective - prevention of the "sacrifice" of life through avoidable accidents. The word "sacrifice" is used here advisedly, as one meaning of the word given in the 1942 edition of Funk and Wagnalls New Dictionary of the English Language is "the act of giving up some desired or valued object for the sake of *** future good." As everyone agrees that life is man's most priceless possession, one wonders if past sacrifices have been in vain.

It appears that life is cheap in America; it is cheap because some of the industrialists are too much concerned with making a profit to devote much time and thought to conserving human life; it is cheap because some labor leaders apparently are interested solely in personal power and prestige; it is cheap because a great many workmen fail or refuse to cooperate energetically with the various organizations interested in their safety and welfare; it is of little value because, individually and collectively, we are indifferent to our responsibilities toward our fellow men.

There is no compelling reason today for the taking of life in industry - in fact, just the reverse is true. It is believed all will agree that we are justified in killing our enemies on the battlefield; also, that each of us is remiss in his duty, not only to his fellow men but also to his country, if he fails to take steps to prevent needless loss of life in

1/ The Bureau of Mines will welcome reprinting of this paper, provided the following acknowledgment is used: "Reprinted from Bureau of Mines Information Circular 7271."

2/ Engineer-in-charge, Bureau of Mines Norton Station, Norton, Va.

725570

Generated on 2024-09-19 13:45 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

industry. From the standpoint of assistance to our armed forces, it is even more necessary to prevent loss of life on the home front, since it is well known that the efforts of several men in industry are required to support one soldier on the battlefield. One thousand or more men lose their lives annually in coal mines; in consequence, 100,000 or more soldiers lose the needed support of supplies made possible by the effort of those miners. Coal is a war necessity, and loss in production due to fatalities in coal mines has a telling adverse effect upon our war program.

COAL-MINE EXPLOSIONS

A major cause of loss of life in United States coal mines is the ignition of inflammable gas or coal dust by an exposed flame, arc, or spark. The sources of ignition of gas and dust are open lights or smoking, arcs from various electrical machines and equipment, improper use of explosives and blasting devices, and, last but not least, the use - rather the misuse - of flame safety lamps.

The elements likely to contribute to an explosion exist in some degree in most, if not all, coal mines in this country. The absence of disasters in any coal mine does not necessarily indicate that effective efforts are being made to prevent them, but rather that some have been more fortunate than others, in that the combination of circumstances necessary to cause an explosion has not existed at the psychological time. This statement may seem drastic; however, it is true that conditions that contribute to mine explosions are brought to our attention almost daily by reports of Federal inspectors of coal mines.

Considerable progress has been made in this country in reducing both the severity and the occurrence of mine explosions; at least, in recent years disasters involving deaths by the hundreds have not occurred as they did 20 to 30 years ago. But, unless practices and methods that are known to have resulted in explosions in the past are discontinued, the recurrence of such disasters is to be expected.

The following is quoted from Bureau of Mines Information Circular 7136: 3/

> Coal-mining men deserve to rejoice over the splendid explosion record of the fiscal year ended June 30, 1939, which was the first consecutive 12-month period in the present century

3/ Harrington, D., and Fene, W. J., Coal-Mine Explosions and Coal- and Metal-Mine Fires in the United States During the Fiscal Year Ended June 30, 1940: Bureau of Mines Inf. Circ. 7136, 1940, 25 pp.

Generated on 2024-09-19 13:50 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

without a major disaster in the coal mines of the United States; but gloom prevails when the record for the fiscal year 1940 is considered. During the past fiscal year 18 explosions, of which 13 were major disasters, resulted in 206 deaths, compared to 14 minor explosions and 16 deaths in 1939. The high fatality rate for explosions in 1940 resulted chiefly from the three major explosions with their 191 deaths.

Many persons believe that virtually all accidents involving injury or loss of life to persons, and especially mine explosions, are preventable. In view of present knowledge of the causes and methods of preventing explosions, the occurrence of these disasters is unwarranted and inexcusable, most especially a disaster caused by a flame safety lamp. Of all the instruments and devices in use at a coal mine, a "safety" lamp should be the safest. But is it? We shall see. It is inconceivable that any reason or excuse can be given for an explosion caused by such a lamp.

The Bureau of Mines has records showing that some of our most disastrous mine explosions, with respect to loss of life, have been caused by the misuse of safety lamps by so-called competent persons. Some of these occurred many years ago; others, more recently. Many resulted from improperly assembled or defective lamps, whereas others were caused by taking lamps apart and attempting to relight them in the presence of gas. To emphasize the importance of the subject at hand, it may be well to mention a few of these catastrophes and near disasters: 4/

1. In 1912, a coal-mine explosion in Colorado killed 12 men and badly burned 1 man. A defective flame safety lamp was the probable cause. This lamp was found, after the disaster, with one of the asbestos gaskets, used to seat the lamp glass, bent and extending downward over the chimney.

2. In the same year, another explosion in a Pennsylvania coal mine badly burned three men. After the explosion, a flame safety lamp was found with the pull-bar and igniter tape missing; thus a hole was left through the bottom of the lamp.

3. In 1916, an explosion in the same State cost the lives of six men. After the explosion, a safety lamp was found with a broken glass and damaged gauze.

4/ Ilsley, L. C., Misuse of Flame Safety Lamps and Danger of Mixed Lights: Bureau of Mines Miners' Circ. 29, 1925 12 pp.

Generated on 2024-09-19 14:20 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

4. In 1917, a Colorado coal-mine explosion caused the death of 121 men. A safety inspector carrying a key-locked flame safety lamp evidently took his lamp apart and attempted to relight it in the presence of gas. After the explosion, his lamp was found taken apart near his body, and there were 22 matches in his clothing. This flame safety lamp was the only one in the mine.

5. In 1919, a West Virginia coal-mine explosion killed a mine foreman and six other men. The foreman was carrying a key-locked lamp with a relighting device. Following the disater, the foreman's lamp was found disassembled, and there were matches in his clothes. Evidently this man's lamp went out, and, failing to relight it with the internal igniter, he took the lamp apart and tried to relight it with a match.

6. In 1921, a gas explosion in a Pennsylvania coal mine killed three men and badly burned three others. After the explosion, the lamp of one miner was found with the thread on the bottom part so badly damaged that the lamp could not be put together properly. Therefore, the lamp was given as the cause of the explosion.

7. In 1923, an explosion in a Wyoming coal mine killed a shot-firer and 98 other men. Following the disaster, a burned match was found near the shot-firer's lamp, which apparently had been taken apart for relighting.

The foregoing are only a few of the scores of explosions caused directly or indirectly by flame safety lamps. Numerous others have oocurred that were due to improperly assembled, defective, or improperly used lamps. A number of years ago the author worked in a mine in Pennsylvania in which a fireboss opened his lamp in the presence of gas and was killed. This man was alone in the mine at the time. A similar instance is remembered in which a fireboss did the same thing not long ago in a West Virginia mine. Recently an official in a mine in Kentucky caused an explosion, in which 12 men were killed, when he attempted to relight his unassembled safety lamp. Only last October, a disassembled key-locked Baby Wolf flame safety lamp was found beside the body of a fireboss in a Tennessee mine. This mine was recovering from a disaster in which 10 lives were lost only last May.

In view of these examples of carelessness, it is obvious that the term "flame safety lamp" is a misnomer. As so many explosions and ignitions have been due to these lamps, how can they be called "safe?"

Generated on 2024-09-19 13:48 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Conversely, no doubt many explosions could have been prevented by proper use of flame safety lamps. It is believed that had a lamp been used, the gas that caused the explosion in the mine in Tennessee would have been discovered and its ignition probably prevented; this is probably true of the explosion that occurred in eastern Kentucky a year ago last October and many others.

The subject "Use and Misuse of Flame Safety Lamps" is a pertinent one today because of the number of explosions occurring in coal mines and because, as we have seen, safety lamps often are the source of ignition. Bureau of Mines records show that 14 explosions occurred in coal mines of this country from January 1 to June 10, 1943.5/ As far as is known, none of these was caused by safety lamps; however, as such lamps often are the source of ignition, a discussion of their use and misuse is highly important at this time.

HISTORICAL RESUME

Flame safety lamps have been used in coal mines for much longer than a century. Originally, they were employed for illumination as well as for detection of gas. The first safety lamp tested underground was a crude affair - a candle enclosed in a metal cylinder. The inlet for air and the outlet for the products of combustion were sealed by water. The air for combustion was forced through the device by a bellows. A window of thick glass permitted inspection of the enclosed flame. This lamp, designed by Dr. William Clanny, was tested underground in a coal mine in 1811. 6/ Shortly thereafter other lamps of various design, invented by George Stephenson and Sir Humphrey Davy, were used in coal mines. The latter is credited with the invention of the first lamp employing a wire gauze to isolate the flame from the surrounding atmosphere. After more than a hundred years, we still depend on the principle discovered by Sir Humphrey Davy that the wire gauze that is part of the housing that surrounds the flame of our modern safety lamps has a cooling effect.

Many improvements have been added, such as the type of fuel used, underfeed ventilation, internal igniters, glass chimneys for extra illumination, shields for protection of the gauze and flame against strong currents of air, and magnetic locks; however, the fundamental principle of the modern flame safety lamp of today is that discovered by Davy in 1815. Though phenomenal progress has been made in the arts and sciences, especially in the development and use of machinery and equipment, we are

5/ Denny, E. H., Confidential Memorandum 1797: Bureau of Mines, June 10, 1943, 8 pp.

6/ Paul, J. W., Ilsley, L. C., and Gleim, E. S., Flame Safety Lamps: Bureau of Mines Bull. 227, 1924, 212 pp.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

still forced, for want of a better device, to rely upon a principle in use considerably longer than a century.

Flame safety lamps are being replaced to some extent by methane detectors, which are safer and much more accurate than the lamps; but these detectors will not indicate the presence of carbon dioxide or a deficiency of oxygen. When old workings are examined in which carbon dioxide or oxygen deficiency may be found, dependence must still be placed on the flame-type detector or flame safety lamp.

PRESENT USE OF FLAME SAFETY LAMPS

Although flame safety lamps have caused many mine disasters, they are almost universally employed in coal mines as a means of detecting explosive or extinctive gas. Their use is widespread, because such lamps are the only device readily available for detecting both the presence of methane and the deficiency of oxygen. However, they are now being supplanted to some extent by electrically operated methane-testing devices, which, though more sensitive and generally more reliable than safety lamps, do not indicate oxygen-deficient atmospheres.

Many of the State mining laws require that flame safety lamps be used in gassy mines; the laws of some States require that safety lamps be kept for emergencies at every coal mine, whether gassy or nongassy.7/

When properly maintained, correctly assembled, and used by a competent and reliable person, a flame safety lamp should not cause an explosion in a coal mine. But since so many explosions have occurred as a result of improper use or use of improperly assembled or defective lamps by workmen and officials, even by fire bosses, mine foremen, and safety inspectors, how can a person be judged to be competent and reliable In States where the laws require that officials be certified, a man usually is considered competent to handle and use a lamp after he has passed the State examination; but does the mere passing of an examination make a man competent and reliable? Obviously, it does not. In fact, D. Harrington of the Federal Bureau of Mines,8/ points out that in three Western States six very disastrous explosions which caused the death of about 500 men and property damage of considerably more than $2,000 000, were set off by flame safety lamps; in each instance the user of the lamp held a certificate of competency as fireboss, gas examiner, or mine foreman, and in at least three of the six cases the official had a certificate of competency

7/ Hooker, A. B., Coggeshall, E. J., and Jones, G. W., Behavior of Flame Safety Lamps in Mine Atmospheres Deficient in Oxygen: Bureau of Mines Rept. of Investigations 3327, 1937, 6 pp.

8/ Harrington, D., Flame Safety Lamp Proves Source of Danger: Coal Age vol. 26, No. 18, October 30, 1934, pp. 610-611.

Generated on 2024-09-19 13:48 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

and experience in Great Britain as well as in the United States. If men of this type, who were judged to be competent by the Governments of two countries, cannot be relied upon to safeguard their own lives as well as those of their fellow workmen, then who can be trusted?

Doubtless, had the higher officials of the companies in whose mines explosions have occurred as the result of misuse of flame safety lamps been asked if the men using these lamps were competent and reliable, the answer would have been "Yes." It would appear that in the light of past experience, coal-company executives should make a definite effort to ascertain whether or not every person whose duty requires him to use a safety lamp can be trusted with a lamp; obviously it is extremely foolish to wait until a disaster occurs before something is done about a matter as important as this.

It seems to be anything but safe to place a safety lamp in the hands of a person who has not demonstrated conclusively that he is thoroughly familiar with the construction of the lamp, the proper method of its assembly, its limitations and proper use, and the danger of tampering with it. Harrington said:9/

> In two cases (explosions), resulting in 220 deaths, the flame safety lamp was taken apart by the fireboss in the mine, and the gas ignition was caused when an ordinary match was being used to relight it ***.

and

> In at least two cases the safety lamps were modern and up-to-date, and although provided with safety igniters or re-lighters, and although these relighters were in place, they were not in condition to use ***.

further

> In two of the six disasters, the ignition was caused by improperly assembled safety lamps and in one case by a misuse of an apparently well-assembled lamp ***,

In the same article, Harrington states:

> One old-time fireboss thought two gauzes made the lamp "slow"; so one gauze was removed***.

9/ See footnote 8.

Generated on 2024-09-19 13:53 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Suppose, as an executive of a coal company, you were about to enploy a fireboss or a foreman in a gassy mine, and you personally knew that the prospective official had had many years experience with a safety lamp in gassy mines; would you demand that this man demonstrate to you that he was thoroughly competent and reliable, and would you check on his work to ascertain that he could be trusted? The chances are that you would not. Yet, one false or careless move with his safety lamp might cause the death of many others and the destruction, or partial destruction, of your mine. We are far too prone to accept as fact that a man is capable without requiring proof that this is true. Shall we continue to ignore this problem, as we have in the past, or will we get busy immediately and prevent (and it can easily be done) the loss of life and destruction of property through explosions caused by flame safety lamps?

Have you checked the flame safety lamps being taken into your mine? The safety rules of many coal companies in eastern Kentucky prohibit the carrying of guns into their mines; but what about the safety lamps that are being taken into these mines daily? These are far more dangerous than any gun, which may cause a single death or half a dozen at the most, whereas a defective, incorrectly assembled, or improperly used flame safety lamp has in several instances been responsible for the death of scores of persons from explosions.

SOME STEPS THAT CAN BE TAKEN TO PREVENT EXPLOSIONS CAUSED BY FLAME SAFETY LAMPS

Use of Permissible Flame Safety Lamps

The problem can be partly solved by absolutely prohibiting the use of unapproved or nonpermissible flame safety lamps in coal mines. We have already seen that a number of catastrophes, with attendant great loss of life and property damage, have occurred as a result of taking flame safety lamps apart underground. Despite this fact, a great many unapproved lamps are still in use, and some have been obsolete for many years. Just a few years ago, the author, while assisting with the recovery work following an explosion in a coal mine in a midwestern State, observed one member of the recovery crew carrying an obsolete, unbonneted, single-gauze lamp. This lamp was in regular use by the owner in a neighboring very gassy mine. Just why any man will cling tenaciously to such an old relic is difficult to understand. Although the modern approved lamp is none too safe at best, it is as much an improvement over the old-type lamps as is the modern automobile over models of 30 years ago.

Generated on 2024-09-19 13:44 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

Since approved flame safety lamps are much safer than unapproved types, obviously they are therefore preferable to the key-locked type. It should not be forgotten, however, that they can become defective through lack of attention to upkeep, and they can be wrongly assembled and used in such manner as to cause external ignitions of gas.

Magnetically locked lamps cannot be disassembled as readily as can the unapproved types; therefore, the tendency to disassemble a safety lamp underground is largely removed when all the lamps in use are of the approved, hence magnetically locked, type. Of course there is no good reason for taking any lamp apart in a mine, unless this is done at a specifically designated lamp station in fresh air, where no possibility of explosive gas exists. If such lamps are given proper attention, repaired when necessary, all parts kept in working order, and properly tested on the surface, there will be little likelihood that they will be tampered with underground. But as no lamp is foolproof, and no individual is infallible, a type of lamp should be used that cannot be disassembled readily. The use of unapproved lamps in mines known to contain gas shows a contempt for the hazards involved.

Every well-informed coal-mining man is familiar with the fact that if explosions are to be prevented other precautionary measures must be taken in addition to the use of approved lamps, such as the substitution of permissible for nonpermissible electrical machinery, the use of permissible explosives instead of black blasting powder and dynamite, effective ventilation, and the use of permissible electric cap lamps; however, a discussion of these is not pertinent to this paper. This discussion will be limited to precautions necessary in connection with the use of flame safety lamps.

Smoking and Carrying Smokers' Articles Underground

One of the evils associated with the use of unapproved safety lamps is the practice of carrying matches into the mine to light extinguished lamps. The carrying of matches (or other smokers' articles) underground is condoned in mines where smoking is permitted; this is a practice that should be prohibited at all mines, whether classed as gassy or nongassy. To insure that smokers' articles are not taken underground, all persons, including officials, visitors, State, Federal, and other inspectors, as well as workmen, should be searched thoroughly before they enter the mine. If the possession of matches (or other smokers' articles) underground is prohibited, another contributory cause of explosions due to safety lamps is eliminated. The Bureau of Mines recommends that smoking should not be permitted in any mine and that employees should be searched frequently for smoking materials, matches, and other

Generated on 2024-09-19 13:52 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

lighting devices in a manner to assure that such articles are not being carried into the mine.

Training Persons Required to Use Flame Safety Lamps

It has been shown that a great many inferentially competent and reliable men have caused disastrous explosions by using defective or improperly assembled flame safety lamps, using these lamps improperly, or taking lamps apart and attempting to relight them in the presence of gas. Proper instruction and training of all persons required to use safety lamps will go a long way toward obviating such hazardous practices.

By proper instruction is meant imparting to the individual thorough knowledge as to the construction of the various types of flame safety lamps, the separate function of each individual part, the correct method of assembling each type of lamp, and the limitations connected with the use of the lamp.

Proper training means showing each person how, when, and where to test for inflammable gas and advising him what should be done when gas is found. His ability and skill in detecting gas should be observed. Each person who uses a lamp should have a comprehensive knowledge of the various mine gases, their origin, composition, and characteristics, and their effects on life, health, and combustion.

It is essential that these men who use lamps be taught the behavior of a flame safety lamp in atmospheres deficient in oxygen. It is reported that the day before a recent explosion a certain official made an examination with a flame safety lamp at a test hole drilled from active into abandoned workings. This official reported that his light had gone out, presumably due to "bad" air (atmosphere deficient in oxygen). The following morning, another official, whose light had also presumably been extinguished by "bad" air, caused an explosion when he attempted to relight his lamp near this test hole. One naturally wonders whether this man knew the effect of the presence of methane or an oxygen-deficient atmosphere, or both, on his safety lamp. The author is inclined to believe that this man was totally unfamiliar with the behavior of a safety lamp under these conditions, otherwise he would not have jeopardized his own life as well as the lives of others by attempting to relight his lamp in the presence of explosive gas. Here is an instance in which 12 lives were lost as the result, presumably, of lack of knowledge of the man who caused the explosion. Where does the responsibility rest for the loss of these 12 lives? Can the total blame be placed on the deceased? The author thinks not. Perhaps that man had never been taught the proper use of a flame safety lamp; he may not have been able to identify the kind of

Generated on 2024-09-19 13:57 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

gas present; or he may not have been able to tell that the amount of oxygen was less than exists under normal conditions. In other words, this man may not have been trained properly. Hundreds of flame safety lamps are being taken into mines daily by men by no means well informed as to their proper use and the dangers incident to their misuse.

The Bureau of Mines has found by experiment:10/

> That when methane is present in a mine atmosphere deficient in oxygen, the flame height *** of flame safety lamps is not a reliable indicator of the percentage of methane or deficiency of oxygen. However, observation of both the height and color of the flame shows reliably the presence of more than 1-1/2 percent of methane or of less than 16 percent of oxygen, or a combination of these conditions and thus gives an adequate safety factor in the detection of either hazard.

How many persons who use flame safety lamps have this information? Further, the same experiments also show that:

> The first evidence of oxygen deficiency is an initial increase in flame height followed by a decrease, unless methane is present. A sustained increase in flame height accompanied by dimming of the flame shows both methane and oxygen deficiency.
>
> The lamp flame is extinguished when the oxygen content falls below 13 percent, no matter how high a percentage of methane is present.
>
> When a flame safety lamp is brought into an atmosphere that is explosive, the flame is extinguished suddenly, with definite popping sounds within the lamp; thus such a lamp is a reliable indicator of explosive atmospheres. The lamp cannot and should not be lighted until it has been removed from the explosive atmosphere.

Should we assume that all persons who use lamps are cognizant of these facts? It will be agreed, the author feels sure, that they should be; but can they be expected to be unless they have first been trained properly?

Necessity for Good Vision; Color Blindness

Another important contributory cause of mine explosions is lack of good sight in the men using safety lamps Ofttimes they fail to discover

10/ See footnote 7

Generated on 2024-09-19 13:49 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

the presence of gas because they cannot see well. There is no doubt that if the eyes of all employees who use safety lamps were to be examined, employers would be shocked to find how many have poor, in some instances extremely poor, vision. In a relatively small though dangerous percentage of gas, a man with poor sight cannot readily observe elongation of the flame that denotes the presence of methane; and, when a closer estimate is desired and the luminous flame is lowered until only a trace of yellow remains, neither can this man with subnormal vision readily observe the gas "cap." Further, a surprisingly large number of persons are "color blind" to some extent, making impossible their observation of the almost nonluminous gas cap.

In consideration of subnormal vision (and color blindness) and the fact that both the gas cap and height of flame are affected by several factors other than methane concentration, it is not surprising that the detection of methane in a mine may be mere guesswork, or that it is missed altogether in many instances. Because of these conditions, the Bureau recommends that the eyes of firebosses and others who are required to test for gas should be in good condition or fitted with corrective lens glasses.

Flame Safety Lamps Should Be Tested Before Being Taken Underground

To make certain that all flame safety lamps are in good condition, they should be tested in explosive gas before being taken underground. In this way, and in this way only, can it be determined readily whether any lamp is "safe." In view of past experiences indicating extreme carelessness of responsible officials and others, the hazards involved are sufficiently great to cause concern even when it is known that the lamp itself is in excellent condition.

It is realized that the job of testing all lamps before they are taken underground is a difficult one at large operations where a great number of lamps are in use; but is the task too great to be overcome when the need for prevention of explosions due to use of these lamps is considered?

SUGGESTIONS FOR CARE AND USE OF FLAME SAFETY LAMPS

1. Only permissible flame safety lamps approved by the United States Bureau of Mines should be used in any mine.

2. Flame safety lamps should be maintained by someone specifically assigned to that duty.

Generated on 2024-09-19 13:51 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

3. Flame safety lamps should be properly cleaned, assembled, and tested after each use.

4. All safety lamps used in mines should be the property of the mine operators.

5. No lamp should be entrusted to any individual until he has demonstrated his ability and skill in handling the lamp and his full understanding of its limitations and the hazards incident to its use.

6. Persons who use safety lamps should have their eyes examined and wear corrective-lens glasses when examination shows this to be necessary.

7. After a man has entered a mine with a properly assembled and tested permissible safety lamp, he should first accustom his eyes to the darkness and when testing for explosive gas should lower his luminous flame until only a trace of yellow remains and carefully note the height of the "fuel cap." (Lamps filled the day before being used will show a smaller "fuel cap" than those filled just before the mine is entered.)

8. When a test is to be made with a flame safety lamp, other lights should be extinguished or covered, and the lamp should be held by the fount and raised slowly into the place to be tested. When practical, the flame should be kept level with the eyes.

9. Enough time should be allowed for a representative sample of the surrounding air to be drawn into the flame. If the presence of gas is indicated, extreme care should be taken that the lamp is not withdrawn suddenly; it should be removed promptly but carefully.

10. Following the discovery of gas, the place should be properly fenced off and a "danger" sign posted; no one should be permitted to enter such place except to remove the gas.

11. Accumulations of gas should be removed under the direct supervision of a competent official; when the accumulation is large, the gas should be removed only when the working shift is out of the mine.

12. A flame safety lamp should only be taken apart underground at specially designated stations in fresh air, where there is no possibility of the presence of methane.

13. At least two permissible flame safety lamps should be kept in proper working condition at every coal mine, and at least two persons

Generated on 2024-09-19 13:42 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY

should be kept well-informed as to the safe maintenance, testing, and use of flame safety lamps.

CONCLUSIONS

Progressive coal companies, aware of the possibility of disastrous explosions, will absolutely prohibit the use of nonpermissible flame safety lamps in their mines for any purpose; they will make definitely certain that all persons who use these lamps, whether workmen or officials, are thoroughly familiar with their construction, proper method of assembly, and correct method of inspection and testing; moreover, they will insist upon proper instruction and training of all persons whose duties require them to test for gas, and they will make certain that these persons are well-versed in the dangers incident to the use of safety lamps in mines in which gas is, or is likely to be, generated.

Such companies will prohibit smoking underground and the carrying of smokers' articles into the mine; they will see that persons who test for gas have good vision and are not "color blind" or that they are fitted with corrective-lens glasses; they will also have all flame safety lamps tested in gas on the surface before they are taken underground.

It is believed that if these precautions are taken, mine explosions due to misuse of flame safety lamps can be prevented.

The continued frequency of explosions in coal mines of this country reminds us that every conceivable precaution should be taken to reduce or eliminate their occurrence. Positively no excuse can be given or accepted for an explosion caused by a flame safety lamp. Of all the preventive measures necessary to eliminate coal-mine explosions, the problem of correct use of safety lamps should be easiest to control.

Generated on 2024-09-19 13:42 GMT / https://hdl.handle.net/2027/osu.32435030643894
Public Domain, Google-digitized / http://www.hathitrust.org/access_use#pd-google
Digitized by Google
Original from THE OHIO STATE UNIVERSITY